# NASA Activities

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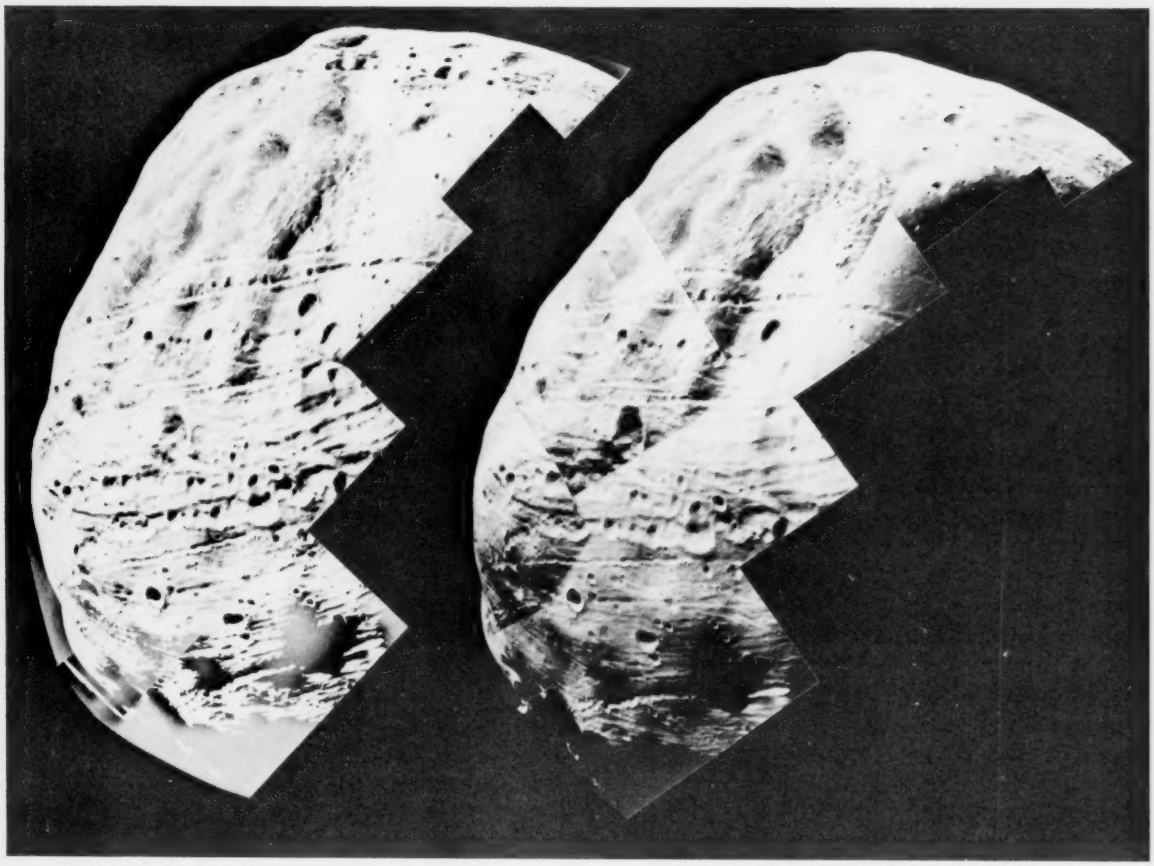

## Cover

**New View of Martian Moon**—This close-up photomosaic of the Martian satellite Phobos shows features that lead scientists to believe the satellite may break apart and eventually form rings around Mars similar to those around Saturn and Uranus. The group of chaotic linear grooves in the middle and lower portions of the picture, not previously observed, may be the result of surface fracturing caused by tidal forces of Mars and impacts with large debris. The photomosaic version at left is from raw images and the picture at right has been computer enhanced. They were taken on May 27, 1977 as Viking Orbiter 1 flew within 300 kilometers of Phobos.

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(Photo used through courtesy of *Citizen Patriot*.)

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# Letter from Washington

Dear Colleagues:

I would like to take this first available opportunity to say "hello" and to tell you how very pleased and proud I am to have joined the world-renowned NASA team.

For me this appointment is a most appropriate turn in a life spent on the frontiers of science and technology. It gives me the very welcome opportunity to guide the government agency specifically mandated by the Congress to lead the way in aeronautical and space science and to pass on the knowledge gained to other sectors of our society for the benefit of all. It gives me the further opportunity to contribute with you to continuing the technological leadership of the United States, leadership which I consider urgently necessary for our economy, for our standard of living, for our role among the nations of the world, and for our national security.

Less immediately practical than technological leadership, but no less important in my view, is the fact that in space we may find the keys to an understanding of eternal questions of creation, life, matter and energy. What scientists would not welcome the opportunity to help lead the search for those answers? From the use of space we can find knowledge to help us solve problems on Earth today, including energy shortages, food shortages and environmental problems. It is a deep satisfaction to be able to participate in the effort to solve those problems.

I find it especially exciting to be joining the NASA team at such a propitious time: with Earth-oriented observation programs beginning to pay off so valuably with regard to agriculture, land use and resources, and greatly increased knowledge of weather, climate and the oceans; with aeronautical technologies identified that in coming years can cut airlines fuel consumption in half and mean huge savings in energy; with the Shuttle approaching operational status and opening the door to a whole new era in space; with the two Voyagers heading for Jupiter, Saturn and the outer planets in late summer; with HEAO-A, bearing its promise of vast new knowledge for mankind, to be launched; with the Space Telescope in prospect for a new, deep, revealing look back into time and space.

I am indebted to Dr. Fletcher and especially to Alan Lovelace for the time and energy they have devoted over the last weeks to bring me "up to speed" on NASA and its operations.

Finally, I find it most significant that when Jim Fletcher was asked, at the end of six years as Administrator, to what he attributed the major successes of NASA under his leadership, he placed at the top of his list the solid professionalism of NASA people across the board, their sense of the importance of their work, and the high standards of excellence both within NASA and among its contractors.

I look forward to associating with such people and I hope to get to know as many of you as possible as we work together for the good of our country and mankind in the coming years.

Sincerely,

Robert A. Frosch

# Monthly NASA Highlights

## Third International Communications Spacecraft in Orbit

The third INTELSAT IV-A commercial communications satellite was launched by NASA aboard an Atlas Centaur rocket from the Kennedy Space Center on May 26. The satellite, which weighs 1,515 kilograms (about 3,340 pounds) at launch will serve in the Atlantic Ocean region. It will remain in geostationary orbit at 340.5 degrees East longitude, where it will provide international communications services to countries from Central America to Iran. The satellite has a seven-year design life and the capacity to relay more than 6,000 simultaneous telephone calls and two television programs.

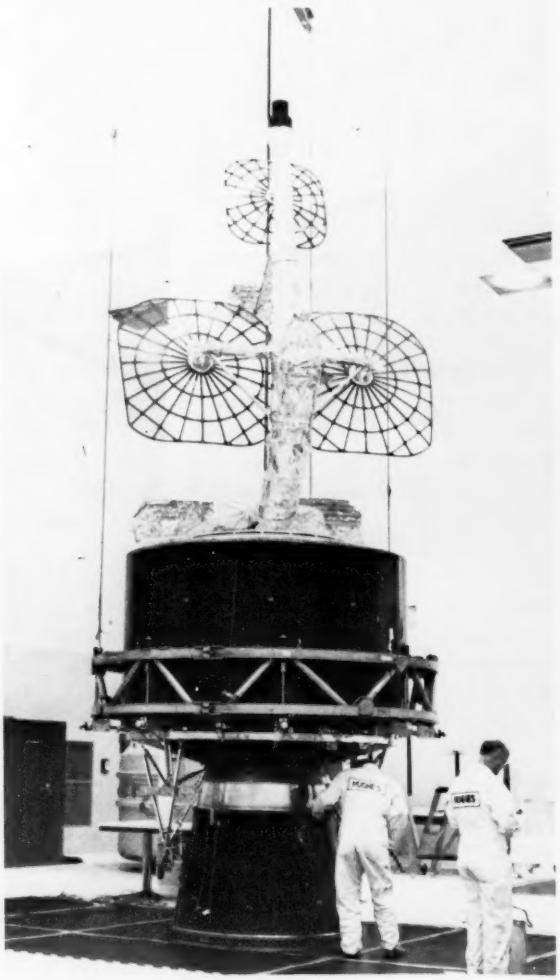
The International Telecommunications Satellite Organization (INTELSAT) owns the satellites. The Communications Satellite Corp. (COMSAT), the United States member, is the management services contractor for the satellite system. NASA is reimbursed for all costs of the Atlas Centaur and launch services by COMSAT on behalf of INTELSAT, under provisions of a launch services agreement.

After an initial placement of the INTELSAT IV-A into an orbit of 548 by 35,787 kilometers (340 by 22,234 miles) it was reorientated to circularize the orbit at synchronous altitude 35,787 km over the equator. At that altitude, because the speed of the spacecraft in orbit matches the rotational speed of the Earth, the satellite remains in position over one spot.

The launch of INTELSAT spacecraft aboard Atlas Centaur rockets requires the coordinated efforts of a large government and industry team. NASA's Lewis Research Center has management responsibility for the Atlas Centaur development and operation; NASA's Kennedy Space Center is assigned vehicle checkout and launch responsibility once it reaches Cape Canaveral. The INTELSAT IV-A satellites are built by the Hughes Aircraft Co., El Segundo, Calif.

The program represents an investment exceeding $295 million by 95 nations. Each launch costs approximately $49.1 million—23.5 million for the satellite and $25.6 million for the launch vehicle.

The NASA team consists of: At headquarters John F. Yardley, Associate Administrator for Space Flight; Joseph B. Mahon, director of launch vehicle and propulsion programs; and F.R. Schmidt, manager, Atlas Centaur. At Lewis: Dr. Bruce T. Lundin, director; Andrew J. Stofan, director of launch vehicles; Richard E. Orzechowski, INTELSAT mission project engineer. At Kennedy: Lee R. Scherer, director; Dr. Walter J. Kapryan, director space vehicles operations; George F. Page, director, expendable vehicles; John Gossett, manager, Atlas Centaur operations; C.A. Terhune, chief engineer, Atlas Centaur; and James N. McKnight, spacecraft coordinator.



**Newest Communications Satellite**—The Intelsat IV-A spacecraft is checked out before launch at the Kennedy center. The satellite is shown atop its apogee kick motor. It was launched by an Atlas Centaur rocket.

## Tilt-Rotor Aircraft in First Hover Flight

The NASA/Army XV-15 tilt-rotor research aircraft made its first flight on May 3 at the Bell Helicopter Textron Center in Arlington, Texas. The flight began with a slow taxi and brief runway takeoffs to check the aircraft's stability and stick position. The aircraft was piloted by Ron Erhart and Dorman Cannon. With the nacelles positioned in the helicopter mode, the aircraft lifted off and made a five-minute hover and low-speed flight. According to the pilots, the XV-15 flying qualities were beyond those anticipated for the first flight.

The aircraft is scheduled to undergo additional ground tie-down tests, a 50-hour airframe and transmission inspection, and installation of a remote control system. It will then be delivered to NASA's Ames Research Center for wind tunnel tests.

## Update on Status of Viking Mission

NASA's Viking orbiter 1 flew at a distance of about 241 km (149 mi) from the surface of the small Martian moon, Phobos, on May 27. A crash was considered a possibility since navigators could not accurately plot the craft's orbit because of irregular local gravity effects when the spacecraft was in such close proximity to Mars. A small orbit change precluded that possibility, however.

The data relay from lander 2, now operating in its automatic winter mode, shows that atmospheric pressures have stopped rising in the Utopia Plain of Mars, which suggests to scientists that carbon dioxide ice is no longer vaporizing into the air at the planet's south pole.

Flight controllers say that all four Vikings will operate in winter mode until October.

**Initial Flight**—The NASA-Army XV-15 tilt-rotor research aircraft makes its first hover flight.

## Shuttle Orbiter Manned Test Flight

The first manned test flight of the Space Shuttle orbiter took place in mid-June at NASA's Dryden Flight Research Center. It followed successful completion of unmanned captive tests.

This flight begins the second phase of the Shuttle approach and landing tests, a program designed to verify the aerodynamics and flight control characteristics of the orbiter. Following the first orbiter/747 flights, which were completed in early March, the orbiter was subjected to verification testing and systems checkout.

## New Environmental Monitoring Satellite in Orbit

A new environmental monitoring satellite, positioned to keep watch over the eastern half of the United States and the Atlantic Ocean, was launched in June, from the Kennedy Space Center, the launch coinciding with the beginning of the hurricane season.

The satellite, GOES-2, is the latest in a series of geostationary operational environmental satellites operated by the Commerce Department's National Oceanic and Atmospheric Administration (NOAA).

It was placed into an Earth synchronous orbit at an altitude of about 35,800 kilometers (22,232 miles) with a velocity which will keep it in position over the equator above South America at about 75 degrees West longitude. From that position, instruments aboard the satellite will let it "see" the development of hurricanes in the tropical Atlantic or Caribbean and follow any movement of the storms. The satellite routinely transmits imagery back to Earth every half hour, day and night, more frequently when necessary.

GOES-2 tentatively is expected to replace an earlier spacecraft of the same series (GOES-1) which has been maintaining the East Coast watch. GOES-1 probably will be moved 105 degrees West to function as a standby spacecraft. Another satellite of the series is positioned above the equator over the Pacific Ocean, monitoring the western half of the United States and the Pacific west to Hawaii.

Hurricane watching is an important mission of the satellite, but that is not its only responsibility, according to David S. Johnson, director of NOAA's National Environmental Satellite Service. Originally conceived as weather satellites, the geostationary spacecraft do produce masses of data important to weather forecasters. They use both visual and infrared imagery for the evaluation of severe storms and to analyze cloud cover, winds, ocean currents, fog distribution, storm circulation, snow melt and other environmental phenomena.

But other instruments on board enable the satellite to receive and transmit information to Earth from data collection platforms on land and in the oceans—information such as water levels in rivers and reservoirs, ocean wave heights, rain and snowfall measurements and the like. Digital data provided by the satellite help scientists determine wind speeds and directions, and cloud heights. Instruments also monitor solar "storms" by measuring x-rays and high energy particles emitted by the sun.

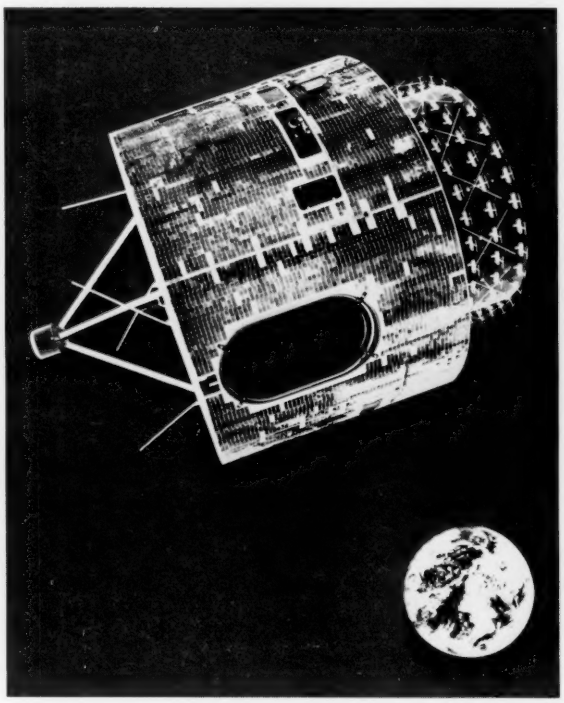
Since May 1974, when the first spacecraft of the series was launched, the use of the kind of data it can provide has expanded rapidly. Today the information is used by such diversified interests as marine shipping companies, forestry officials, farmers and commercial fishermen.

Infrared radiometers provide Atlantic Coast and Gulf of Mexico shipping with precise information on the locations of the Gulf Stream and the Loop Current, enabling ships to either make use of, or avoid, those currents. Gulf fishermen also use the information as an aid to the location of productive fishing grounds.

The Coast Guard and Civil Air Patrol use geostationary satellite data in their search-and-rescue efforts, and current research projects indicate imagery and digital data provided by the spacecraft may be of use to agricultural interests by showing phenomena such as freeze lines and soil moisture content.

GOES-2 was manufactured by Ford Aerospace and Communications Corp., as were the first three spacecraft in the series. NASA's Spaceflight Tracking and Data Network provides necessary support for the mission. The tracking stations include the Minitrack Network and stations at Guam; Orroral, Australia; Santiago, Chile; Quito, Ecuador; Rosman, N.C.; and Wallops Island, Va.

The Goddard Space Flight Center has contract and systems management responsibility for the spacecraft and performed in-orbit testing of the satellite until it was turned over to NOAA for operational use about 30 days after launch. ■■■



**Keeping a Watch on Earth's Environment**—An artist's concept of how GOES-2 appears as it orbits Earth almost 36,000 kilometers high. The spacecraft was launched for NOAA on June 16, 1977.

## Image Enhancement—The Future Documents the Past

*The following article is reprinted from NASA's Jet Propulsion Laboratory's house magazine, JPL Universe, dated May 20.*

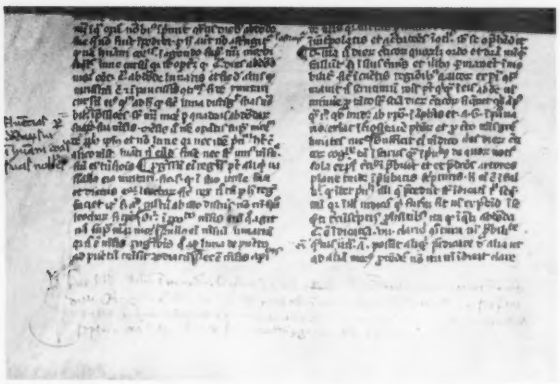
Complex image enhancement techniques originally developed for the space program currently are being used to investigate records of man's history on Earth.

Two medieval documents—a fragment of Cicero's *Republic* and a 14th century medical work—are being studied at NASA's JPL under the direction of Dr. John F. Benton of the Caltech Division of the Humanities and Social Sciences.

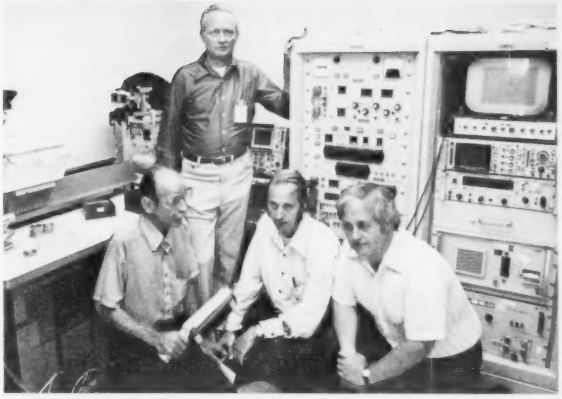
The immediate objective of the study is to decipher erased or faintly visible words on the valuable parchments. The ultimate goal is to design equipment for manuscript study in museums and libraries.

Under a grant by Caltech for the application of space technology to other uses, Benton is collaborating with G. E. Danielson and Dr. Terrence Reilly of the space instruments and photography section, and with James Soha and Alan Gillespie of JPL's image processing lab.

They are using the breadboard model of the vidicon camera developed for Mariner spacecraft imaging science experiments. This camera scans and measures the brightness of hundreds of points along hundreds of lines in the field of vision in the manuscript. The degree of brightness, or gray level, for each point is recorded on magnetic tape on a scale from zero for jet black to 255 for white.



**Unraveling Ancient Mysteries**—The marginal notes that can be seen at the bottom of this photograph of a 14th century medical journal were virtually invisible—they had been erased—before image processing techniques revealed the handwriting. Additional image enhancing projects are being carried out at NASA's JPL.



**Experts in Complex Camera Work**—The Vidicon camera in center of photo begins the complicated procedures used to discern nearly invisible markings on cloth or paper. Program personnel (l. to r.) Dr. John Benton (Caltech), Bill Magruder, James Soha and Dr. Terence Reilly supervised photography of the centuries-old parchment document under study.

The information is then "read" by a computer, where it is filtered to remove shading, and "contrast-stretched" to a level that makes otherwise invisible marks visible to the naked eye.

Thus, the processes designed to produce pictures of the Earth, Moon, and Mars from weak satellite or spacecraft television signals, are now used to retrieve weak images of writing on the parchments.

According to Benton, most museum collections contain manuscripts with portions that can't be read. For example, he cites the British Museum collections of papal letters, charred in a 1731 fire in London, and the erased portions in the letters of Dorothy Wordsworth in the Huntington Library.

Benton's work has been done primarily on a 14th century copy of the *Speculum Medicine* written by a medieval Catalan physician, Arnald of Villanova, who was a physician to kings and popes. The manuscript was loaned to Benton by its current owner, Beverly Hills physician Irving J. Pincus.

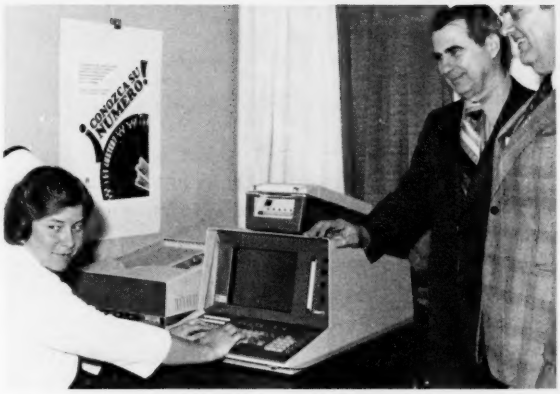
Numerous annotations have been made on the document by generations of owners. And a particular marginal note, stating, "You are lying, for he was born near Daroca in the kingdom of Aragon . . ." motivated Benton and Pincus to try to determine the authorship of the marginal accusation.

Discovering historical revelations from the Villanova manuscript is not, however, the main purpose of Benton's work. Having demonstrated the advantages of the electronic camera method over other currently used procedures, Benton now intends to promote the design of an image processing system specifically for manuscript reading.

Results of the study thus far have aroused the interest of Vatican librarians and other international scholars, whom Benton and Gillespie visited in the fall of 1976.

At the present time, however, the JPL equipment and other similar space cameras are costly to operate and inaccessible to most major manuscript libraries. Benton and his JPL colleagues, therefore, hope to develop portable, less-expensive equipment than can be operated by a moderately skilled technician.

According to Benton, "A society that can land a camera on Mars, can use that technology to solve the more recalcitrant problems of the past."



**Computing Cardiovascular Risks**—Nurse Suzanne Ashby enters blood pressure into graphics display terminal. Looking on are G. Fernandez, Assistant Associate Administrator for Center Operations (Systems Management), and Dr. Walton L. Jones, Director of Occupational Medicine.

## Cardiovascular Risk Factors Assessed at Headquarters

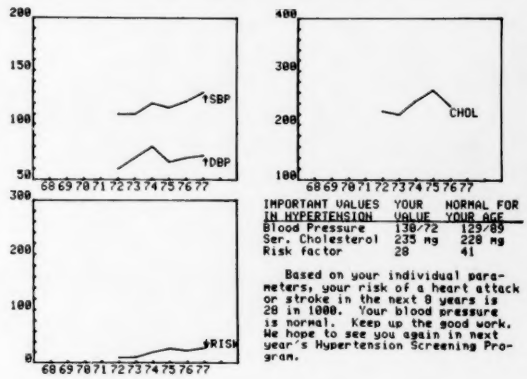
May was National Hypertension Awareness month. At headquarters, employees were provided by the offices of information systems and occupational medicine with blood pressure screenings and calculations of how vulnerable they might be to a heart attack or stroke during the next eight years. The risk factor was based on a table from the Framingham cardiovascular study. More than 1,000 persons were screened, including half of those stationed at headquarters. Of those screened, 19 percent had elevated blood pressures that required further checks by the health clinic or private physicians.

The high participation rate probably was generated by the medical routine, in which a computerized report of test results was given to each person examined. The report was produced by an automated data retrieval and display system developed by NASA's information systems office. A graphics display terminal was used to access and summarize each patient's health data and to calculate the risk of developing cardiovascular disease on the basis of age, sex, smoking practice, cholesterol level and blood pressure. For employees who had previously received physical examinations in the heath unit, the computer report charted their history of blood pressure, cholesterol and risk values.

In 1976 and again this year, this special hypertension screening program reached employees who were not regular participants in occupational medicine's routine comprehensive physical examination program. It also provided an opportunity for patients under private medical care for hypertension to check on their progress and to be reminded of the importance of following their treatment program for control of hypertension.

A sample printout of cardiovascular data obtained during the -

NASA 1977 Hypertension Awareness Program




| IMPORTANT VALUES IN HYPERTENSION | YOUR VALUE | NORMAL FOR YOUR AGE |
|---|---|---|
| Blood Pressure | 130/72 | 129/89 |
| Ser. Cholesterol | 235 mg | 228 mg |
| Risk factor | 28 | 41 |

Based on your individual parameters, your risk of a heart attack or stroke in the next 8 years is 28 in 1000. Your blood pressure is normal. Keep up the good work. We hope to see you again in next year's Hypertension Screening Program.

## NASA to Buy New Vehicles for Shuttle Use

NASA has decided to purchase six spinning solid upper stages to permit delivery of spacecraft from an orbiting Space Shuttle to higher Earth orbits. This marks initiation of the agency's first procurement action following agreements earlier this year with two aerospace firms, permitting them to design, test and manufacture the upper stages and market them independently.

A request for proposals was issued May 13 by the Marshall Space Flight Center for six SSUS-A vehicles to place Intelsat-5 type spacecraft into stationary

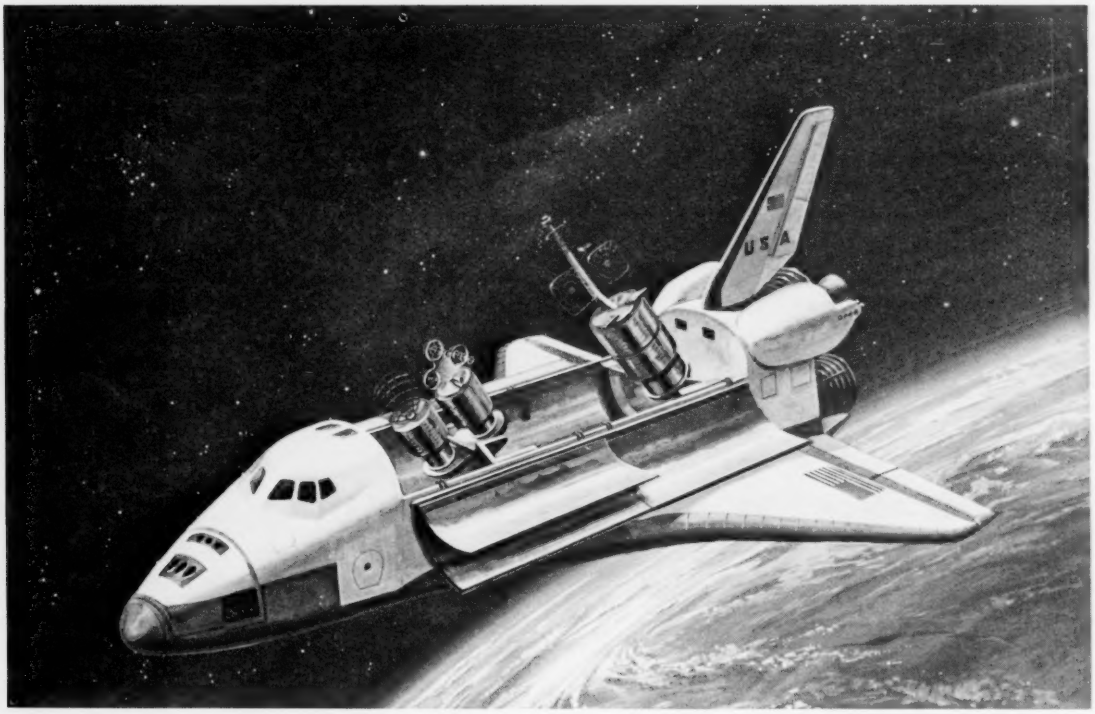
orbits, with an option for purchasing two more. The "A" designation indicates the vehicle's capability to deliver payloads of the size now being launched by the expendable Atlas Centaur rockets.

Bids on the procurement action are limited to two firms, the McDonnell Douglas Corp. of Huntington Beach, Calif., and the Boeing Aerospace Co. of Seattle. Both companies signed agreements with NASA which committed them to develop the stages with private funds, in a new procedure for NASA. Ordinarily the agency absorbs development and production costs as part of a procurement agreement.

Included in the purchase of the six upper stages are all hardware, analyses, logistics and services necessary to accomplish the successful injection of the spacecraft into its proper transfer orbit after the Space Shuttle orbiter has placed the SSUS and its spacecraft into the proper injection position and orientation.

Under terms of the proposed contract, the contractor will have responsibility for production of the vehicles, the services, and safe and proper operations of the upper-stage systems.

The first of the six vehicles is to be delivered to NASA for a launch in December 1979, for a demonstration flight. Three other stages will launch Intelsat 5s, the Comsat advanced communications spacecraft. The remaining two will be held in reserve for other mission assignments.




**Space Spinners**—In this picture, two Delta class and one Atlas Centaur class spinning solid upper stages (SSUSs) are shown in launch configuration with satellites attached in the cargo bay of the Space Shuttle orbiter. The SSUS is planned to replace the expendable Atlas Centaur and Thor Delta launch vehicles now in use. Extended from the orbiter's cargo bay on a cradle with a spin table, the SSUS and its satellite are aligned by the orbiter, then spun like a top—so that attitude is maintained in space, thereby making a guidance system unnecessary—and then ejected. After a certain distance is reached, the solid propellant engine will ignite for the boost into a transfer orbit. After burn, the satellite will separate from the SSUS and continue its journey. The SSUS is then expended and the orbiter returns to Earth with the cradle intact, to be used again.

## NASA, Soviets Extend Manned Space Flight Cooperation

NASA and the USSR Academy of Sciences have agreed on further cooperation in manned space flight. The agreement was signed May 6, 1977, by Dr. Alan M. Lovelace, then Acting Administrator of NASA, and May 11, by Anatoly P. Aleksandrov, the President of the Academy of Sciences of the Soviet Union.

The agreement is designed to provide continuity of the joint technical, scientific and operational capability developed through the highly successful Apollo Soyuz rendezvous and docking mission conducted in July 1975. Three joint working groups will prepare recommendations for two new programs, one dealing with orbital manned flight activities and the other with a possible international space station.

The first working group will begin studies soon on scientific and applications programs that may be conducted in joint operations of the American Space Shuttle and the Soviet Salyut space station in the early 1980s. A second working group simultaneously will develop plans for these joint operations. The two groups will seek to define projects that might benefit from the flexible delivery capability and large capability for longer stay-time in orbit represented by the Soviet Salyut. The emphasis will be on a "science first" program which will take advantage of these capabilities and fully justify the contemplated joint operation.

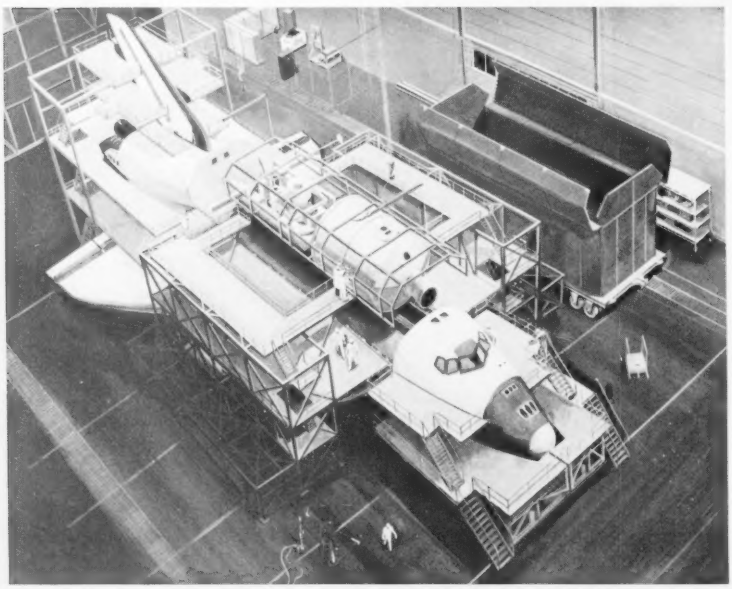
Studies of the Shuttle/Salyut program should be completed within 18 to 24 months, and should produce recommendations for consideration by both sides.

The agreement also establishes a third joint working group whose task will be to conduct a series of phased studies of an international space platform, or station. If such studies establish a consensus on the objectives of future space stations, further studies would be undertaken to explore possible agreement on their conceptual design.

Neither side is committed to steps beyond the initial studies and each reserves the right to proceed with its independent national space-station interests. The agreement does, however, establish the possibility that the two sides may be able to combine their space station interests to some degree, thereby offering potential economies and efficiencies.

The full text of the agreement follows.

"In accordance with the Agreement on Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes between the USSR and the USA, dated May 24, 1972, and taking into account the results of discussions held in Washington, October 19-22, 1976, between the delegation of the USSR Academy of Sciences, headed by the Chairman of the Intercosmos Academician B. N. Petrov, and the Delegation of the National Aeronautics and Space Administration of the USA, headed by the NASA Deputy Administrator, Dr. A. M. Lovelace, the Academy of Sciences and NASA agree to undertake the following steps for further development of cooperation between the USSR and USA in the exploration and use of outer space for peaceful purposes.



**Orbiting Laboratory**—An artist's view of how Spacelab will look when it is installed in the Space Shuttle orbiter's cargo bay. Because it will travel repeatedly aboard the Shuttle, Spacelab—under development by the European Space Agency—may be configured in many ways to accommodate many experiments. The Marshall center is the lead NASA center for Spacelab; launch will be at the Kennedy center.

I. **Study of the Objectives, Feasibility and Means of Accomplishing Joint Experimental Flights of a Long-Duration Station of the Salyut-Type and a Reusable "Shuttle" Spacecraft (Salyut-Shuttle Program)**

In view of the fact that the long orbital stay-time of the Salyut-type station and the capabilities of the Shuttle spacecraft commend their use for joint scientific and applied experiments and for further development of means for rendezvous and docking of spacecraft and stations of both nations, the two sides agree to two joint working groups (JWGs) of specialists, charging them with studying the objectives, feasibility and means of carrying out a joint experimental program using the Soyuz/Salyut and Shuttle spacecraft:

—a JWG for basic and applied scientific experiments.

—a JWG for operations.

Within 30 days after the Agreement becomes effective, the sides will inform each other of the initial leaders and composition of these JWGs. The work of both groups should begin simultaneously. The composition of the JWGs can be changed or enlarged at any time as necessary.

Appropriate sub-groups can be formed.

In their studies, the JWGs should proceed on the assumption that the first flight would occur in 1981. The final date would be set in the course of the joint work.

**First Phase of the Joint Working Groups' Activity**

The following preliminary project documents should be prepared within 6-12 months after the agreement comes into effect:

—preliminary proposals for scientific experiments;

—preliminary technical proposals for carrying out the program;

—preliminary schedules for implementing the program.

**Second Phase of the Joint Working Groups' Activity**

The JWGs should prepare the following definitive documents within one year of joint work in the second phase:

—a technical description of the joint program and its realization;

—a scientific program for the joint flight;

—a schedule for conducting the joint work;

—an organizational basis for implementing the program;

—a list of additional joint technical documentation which may be required.

The sides will make the final decision on implementing the program at the end of the second phase of the JWGs' activity.

The working period of the JWGs in the first and second phases of their activities can be shortened.

Each side will consider the accommodation on its spacecraft of payloads proposed by the other side for flight in the Shuttle-Salyut program. Such accommodation will be undertaken where both sides agree that the payloads concerned are of mutual value and interest.

II. **Consideration of the Feasibility of Developing an International Space Platform in the Future (International Space Platform Program)**

Both sides recognize that no commitments are made at this stage concerning the realization of any project for creating an international space platform.

The sides agree to establish a Joint Working Group of specialists for preliminary consideration of the feasibility of developing an International Space Platform on a bilateral or multilateral basis in the future.

The JWG will carry out its work on the basis of studies conducted by each side independently and also by the two sides jointly, proceeding from each of the following stages to the next as may be mutually agreed;

—define at the first stage the scientific and technical objectives which would warrant the use of such a space platform.

—consider possible configurations appropriate to the objectives identified.

—formulate proposals on the feasibility and character of further joint work which may be desirable in this field.

At the first stage of its activity, the group will work in close coordination and contact with the JWGs set up to consider ways to realize the Salyut-Shuttle program.

The sides will appoint the initial leaders and members of the JWG for this program within two months after the Agreement goes into effect. This JWG should formulate preliminary proposals on possible scientific-technical objectives which could be achieved by an international station one year after beginning its work.

This Agreement comes into force at the moment it is signed by both sides."

## Numerous Proposals Received for Space Processing Experiments

NASA's Marshall center, the lead NASA center for the Spacelab program, has received 119 proposals from researchers for materials processing experiments to be performed on flights of Space Shuttle and Spacelab.

The proposals, submitted in response to an announcement issued several weeks ago by NASA's Office of Applications, include applied and basic research projects in branches of materials science where weightlessness and the absolute vacuum obtainable in orbital flight can be exploited to unique advantage.

An engineering and business evaluation of the 119 proposals was performed by a team at the Marshall center and the Office of Applications is expected to announce the chosen projects—probably 10 or 20—by the end of July. Projects relevant to eventual development of useful applications of space flight will be given priority.

Spacelab is a cooperative venture between NASA and the European Space Agency; the Marshall center has been given project management responsibility for the first three Spacelab payloads.

**Preview of Space Construction**—In the neutralized gravity environment of the Marshall center's neutral buoyancy simulator, a space-suited employee performs the task of joining two structural beams, a typical effort when structures are built in space.

## Recompression Chamber on Loan to Florida University

The Kennedy Space Center's hyperbaric chamber has been loaned to the College of Medicine at the University of Florida in Gainesville for hyperbaric medicine and research. The value of hyperbaric or recompression chambers is for the treatment of pressure-induced accidents usually occurring underwater—conditions such as embolisms, decompression sickness ("bends") and other medical problems that require the administration of hyperbaric oxygen (oxygen administered under increased pressure over a long period—usually 12 to 24 hours— in a sealed chamber). These specially equipped chambers also are used to treat carbon monoxide poisoning, gas gangrene and other ills, including certain aviation problems such as the "bends" caused by exposure of a human body to extremely high altitudes followed by an abrupt return to pressures within Earth's atmosphere.

Located in the operations and checkout building in the KSC industrial area, the hyperbaric chamber was designed for treatment of astronauts if decompression sickness occurred during their participation in manned altitude chamber tests of the Apollo spacecraft.

Upon completion of the Apollo Soyuz Test Project in the summer of 1975, there was no operational requirement for the altitude and hyperbaric chambers and all of them were deactivated.

Though deactivated, the altitude and hyperbaric chambers were preserved so that they may be reactivated if required for Space Shuttle activities.

The hyperbaric chamber was available to the public for treatment of decompression sickness from Feb. 1968, through Aug. 15, 1975. A total of 13 patients—all of them SCUBA divers—were treated at the center during that period.

The new loan agreement extends through December 31, 1979, unless extended by mutual agreement of KSC and the University of Florida.

## Drought in Western States the Subject of NASA Studies

Earth-orbiting satellites may prove to be a new and valuable tool in the seasonal prediction of water supplies from snow runoff in California's Sierra Nevada and other western mountains. The continuing drought in western states is a direct result of below normal snowfalls in the mountains, the source of streamflow water supplies.

A major test of the satellites' capacities to assess potential water supplies to drought-stricken regions presently is underway in a joint project involving the water management agencies of Arizona, California, Colorado and Oregon.

"Positive results already have been obtained in previous research projects. The current four-year operational program is intended to test the concept under working conditions," said Dr. Albert Rango, a research hydrologist at NASA's Goddard Space Flight Center.

California is the hardest hit of the western states, experiencing its second consecutive drought year caused by scant snowfalls in the Sierra Nevada. Runoffs from those mountains supply water for the whole central valley of California. Many of the reservoirs on the western slopes of the mountains were dry this year as early as May. Landsat satellite imagery shows that the Sierra's snowlines for 1977 are far reduced compared to those of 1975, a near normal year.

"Not only do we have less area of snowpack, but it is a thinner layer according to information from in-place snow sensors and ground measurements made by snow survey teams," said A.J. Brown, coordinator of California's cooperative snow survey program. He is chief of the snow surveys branch, Calif. Dept. of Water Resources at Sacramento, one of the cooperating water management agencies.

Some areas face more severe drought conditions than others, depending largely upon whether the drought has existed for one year or two. In Colorado, for example, the snowpack is 25 to 40 percent normal in the Rocky Mountains. The state expects to fare reasonably well because of adequate reserve storage from near-normal mountain runoff last year.

The "big picture" capabilities provided by satellite are less expensive and faster than conventional aerial surveys. Satellites also can map the same snow cover area repeatedly under a relatively constant viewing perspective.

"Used as an additional prediction tool in the hands of the operational water agencies, satellite imagery may help improve water availability forecasts. Advance warning of low water supplies is necessary for the most effective use of available water," Brown said.

Cooperating in the satellite snow mapping project are: U.S. Geological Survey, Phoenix, Ariz., and Tacoma, Wash.; U.S. Soil Conservation Service, Denver, Colo.; Bonneville Power Administration, Portland, Ore.; National Weather Service, Portland, Ore.; Calif. Dept. of Water Resources, Sacramento; Arizona Salt River Project, Phoenix; and Colo. Division of Water Resources, Denver.

## Planning for a Rendezvous with Halley's Comet

A unique new propulsion system under study by NASA may be used to propel a spacecraft to a historic rendezvous with Halley's Comet when it crosses Earth's orbit in 1986. A solar electric propulsion system, it and the "Solar Sailer" are under consideration for such a mission at three NASA field centers.

The large, active Halley's Comet has been observed from Earth during 30 appearances since 467 B.C. A detailed study of its composition is considered important in unraveling theories about the creation of the solar system, which is why a rendezvous mission is under study at NASA. The comet will be at its most active state in late 1985 and in 1986 as it passes near the Sun.

The NASA installations involved in studies that could lead to a Halley's Comet mission are: the Marshall Space Flight Center; the Lewis Research Center; the Jet Propulsion Laboratory; and the Goddard Space Flight Center.

The solar electric propulsion system proposed by the Marshall center employs solar energy concentrated by reflectors onto conventional silicon solar cells to provide electrical power for the operation of eight ion engines. The engines and associated power processors have been developed and tested for several years at the Lewis center.

The spacecraft, as it is being defined by NASA's JPL, would be equipped with a wide variety of scientific instruments, including an imaging system to transmit pictures of the comet to Earth. A separate probe might be carried to penetrate the tail of the comet and approach the nucleus to determine its physical characteristics.

Marshall center engineers propose a launch between March and June 1982 aboard Space Shuttle. Once deployed in space by the Shuttle, the system and spacecraft would receive a boost of escape speed from a twin-stage interim upper stage, under development

by the Department of Defense with NASA, coordinated by the Marshall center. If all the steps are successful, the propulsion system would carry the craft on a three- and one-half year journey—more than 965 million kilometers (about 600 million miles)—to the selected rendezvous point.

Goddard center scientists also are involved in the Halley's Comet science working group, which is planning the measurements and observations to be carried out in this historic space flight.

The rendezvous would take place at a point just outside the "dust" cloud some 50,000 kilometers (31,070 miles) from the nucleus. The primary propulsion function of the system would then be completed, but it would continue to maneuver the spacecraft and provide electrical power to help accomplish scientific chores.

Marshall center engineers hope the design will be adaptable to a wide variety of other missions—on Earth and on other planets.

NASA is scheduled to make a decision in August this year about which of the two concepts would be the more desirable for a possible rendezvous with Halley's Comet in 1985.

## First High Energy Astronomy Observatory Awaiting Launch

NASA's first High Energy Astronomy Observatory, HEAO-A (HEAO-1 once in orbit) is expected to be launched this fall, inaugurating a three-mission program to study some of the most intriguing mysteries of the universe—pulsars, quasars, exploding galaxies and black holes in space.

The observatories—the heaviest Earth-orbiting satellites ever launched—will carry scientific instruments capable of detecting, with high sensitivity and resolution, X-rays emitted by stellar sources throughout the universe. Data on celestial gamma rays and cosmic rays also will be collected. Such high energy rays cannot be studied through Earth-based telescopes because our atmosphere obscures them. Initially the rays were observed by instruments on sounding rockets and balloons and by small satellites without the instrumentation capabilities required for high-data resolution and sensitivity. The HEAO satellite does have the necessary capabilities. The spacecraft, rotating end-over-end, will survey the entire sky in six months.

Two other unmanned scientific satellites, HEAO-B and HEAO-C, will be launched in 1978 and 1979. The HEAO-B mission will maneuver and point for long periods at selected X-ray sources mapped by HEAO-A and smaller X-ray spacecraft, while HEAO-C will conduct a survey of gamma-ray emissions and study cosmic ray particles from our galaxy.

HEAO-A and HEAO-C, designed to perform sky surveys, are classified as scanning missions. They will rotate slowly end-over-end, with one revolution about every thirty minutes. Each will use a gas thrust reaction control system to maintain proper sky-scanning orientation so that the solar arrays face the Sun at all times to provide electrical power for the satellite.

For HEAO-B, which must point to specific stars or points in the sky, reaction wheels are added to provide a precise and highly accurate pointing capability of one arc minute or better. HEAO-B is termed a celestial pointing mission.

The HEAO-A and HEAO-C observatories will have a mission lifetime of six months each, which is the time required to map fully the celestial sphere. HEAO-B will have a mission lifetime of one year for pointing at selected X-ray sources.

The observatories, 5.8 meters (17 feet) long and weighing 3,150 kilograms (7,000 pounds), will be placed in low circular orbits, about 420 to 460 kilometers (363 to 390 miles) above Earth. The altitude is far enough above the atmosphere to detect the radiation, which cannot reach the ground.

X-ray and gamma rays are composed of photons, which are particles having energy but no mass, as in light rays. Cosmic rays are composed of particles such as electrons and protons, which have both mass and energy. An X-ray has thousands of times the energy of ordinary light and gamma rays millions of times the energy of visible light.

The high-energy X-rays and gamma rays which HEAO will study, traveling through space at the speed of light, are called electromagnetic radiation. Other electro-magnetic forms include ultraviolet and infrared radiation.

Man has studied these forms of radiation and their energy mechanism for many years and has transformed them into many practical uses, including electrical applications, holography, radio and television, radar and infrared photography.

In high-energy astronomy, interest is in the extreme short-length waves which are known as X-rays and gamma rays. These rays are produced on Earth in both natural radioactive materials and man-made processes. The X-rays and gamma rays on the Earth are produced from well understood physical processes and they are used routinely in physics, chemistry, engineering, medical and other scientific fields. Earth-produced radiation is made by mechanisms involving

the atomic and nuclear structure of the elements, but little is known about the way in which X-rays and gamma rays, with their great energy, are produced and accelerated from deep space toward Earth.

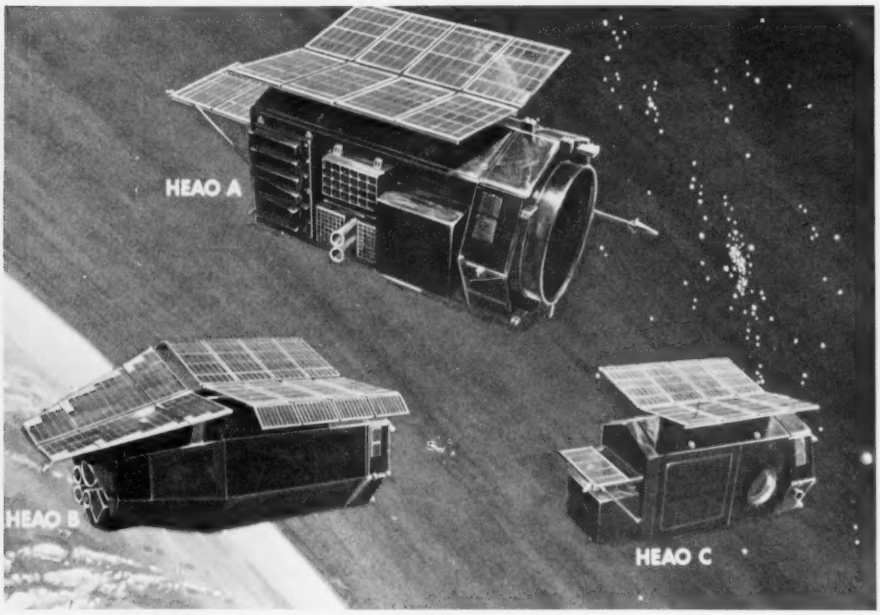
It is expected that the radiation data collected by the HEAO observatories, after having been reduced and analyzed, will lead to a better understanding of how the extremely high energies are generated in space, how basic elements are formed, how the universe evolved and the extreme physical processes evident within the universe.

The HEAO project is managed for NASA's Office of Space Science by the Marshall Space Flight Center. The OSS program manager is Richard E. Halpern and the program scientist is Dr. Albert G. Opp.

At the Marshall center, Dr. Fred A. Speer is project manager. Project scientist for HEAO-A is Dr. Frank B. McDonald of NASA's Goddard Space Flight Center. Prime contractor for the program is TRW Systems of Redondo Beach, Calif.

All HEAO observatories will be launched by Atlas Centaur vehicles from NASA's Kennedy Space Center. KSC manages the launch operations, including prelaunch checkout, launch and flight through observatory separation in orbit. NASA's Lewis Research Center manages launch vehicle procurement and activities for the HEAO program.

Control of the in-orbit HEAO observatories will be under the direction of Marshall in conjunction with TRW flight control engineers at Goddard.




## Theories about Evolution Presented

Does man owe his evolutionary existence to a barrage of huge asteroids that struck the Earth, the Moon and the other inner planets in the solar system billions of year ago? Are the modern ocean basins the product of giant impact craters that formed early in the history of this planet? If so, what are the consequences for life elsewhere in the universe?

These are some of the questions posed by Dr. Harvey Frey, a NASA-University of Maryland scientist working at NASA's Goddard Space Flight Center, in a paper presented last month at the Washington, D.C. meeting of the American Geophysical Union.

Information returned from Apollo lunar landings and photographic evidence from spacecraft studies of the Moon, Mercury and Mars seem to show that all these planets experienced an intense bombardment by asteroids 50 kilometers (30 miles) or more in diameter some four billion years ago. This catastrophic cratering also must have affected the early Earth.

Building on the work of other scientists—including that of Dr. Paul Lowman's (Goddard) studies of crustal evolution—Frey suggests that this early destructive bombardment may be responsible for the first ocean basins formed on the Earth.

Giant impacts would have triggered subsurface melting, leading to vast outpourings of lava that would

have flooded the huge craters caused by the impacts.

Frey also suggests that these conditions make possible a very early beginning of plate tectonics, a phenomenon in which large rigid crustal blocks shift position at the Earth's surface. Such movements are seen as the cause of earthquakes and volcanic eruptions today. Formation of basins flooded by basaltic lavas is necessary for plate motion to be set in motion. According to Frey, "Crustal uplift and rifting were probably initiated in the thinned crust of the Earth's mare basins. Loading of these basin margins by sediments encouraged subduction, which initially probably was confined to the continent-ocean (highland-mare) interface. With subduction (sinking of crustal plates) established, sea-floor spreading at mid-mare ridges could begin the long process of oceanic crustal reworking, which after several cycles would eventually generate the young oceanic crust of the modern plate-tectonics period."

Four billion years ago the Earth would have looked much like the Moon does today. The Moon never had plate tectonic motions, because of the rapidity with which it cooled.

Frey says that had there been no asteroidal bombardment in the distant past, the evolution of life on the Earth would have greatly differed from its established pattern. For example, the Earth might well have been covered with a global ocean, with no continents and no islands, nothing but water; or it might have been mostly dry land, with only a few patches of water here and there; many of the higher life forms, including man, might not have evolved.

Origin of continents and ocean basins has long been a problem in geologic research. The most likely explanation is asteroidal bombardment, according to Frey, who says: "It is obvious that the Moon, Mercury and Mars were struck by hundreds of huge objects approximately four billion years ago. There is no way the Earth could have escaped such a pounding. My calculations show that more than 50 percent of the Earth's original crust would have been converted into ocean basin topography based on the number, diameter and depth of the observed lunar basins."

If asteroidal bombardment is responsible for the original ocean basins of the Earth, then intelligent life elsewhere in the universe may also depend on such a catastrophic event. Frey says, "There is no reason to believe that similar events would have occurred in the same time frame on other Earth-like worlds in other star systems." Timing of the bombardment is critical. If too early, they would have impacted molten crust and no traces would remain. If much later, *after* life had formed, evolution would have been seriously affected. Intelligent life forms might not have had time to evolve.

In answer to questions about the existence today of giant asteroids in the solar system and the likelihood that they might hit the Earth, Frey said:

"The best modern example are the Apollo asteroids which have orbits that cross the orbit of the Earth. None of these are likely to hit the Earth in the forseeable future."

## Nimbus-6 Tracking North Sea Oil Slick

Norway's *Det Norske Meterorologiske Institutt*, Oslo, has asked NASA to use its Nimbus-6 satellite to track buoys dispersed in the huge oil slick resulting from the recent oil well blowout in the North Sea.

In a May 2 message to NASA's Goddard Space Flight Center, the Norwegians said they had placed five random access measurement system (RAMS) drifting buoys in the oil slick between May 4 and 16. The buoys are designed to transmit various kinds of environmental information to the satellite as they drift in the ocean. They also can be accurately tracked by the same satellite—in this instance, NASA's polar-orbiting Nimbus-6 meteorological satellite—as it passes some 1,100 kilometers (680 miles) overhead several times a day. The buoys originally were designed by the Norwegians for research purposes.

William W. Conant, a Goddard engineer, said, "Because of the nature and importance of the request, we are supporting the effort and transmitting locations of all the buoys twice daily for 30 days. We don't normally provide this service to users."

Conant said similar buoys were used earlier this year to assist the Coast Guard in tracking the slick resulting from the *Argo Merchant* oil spill off Nantucket Sound. He said the buoy platforms provide an accurate, all-weather method of tracking, especially when aircraft cannot be used. When air surveys *are* possible, the position information collected by buoy tells aircraft where to go for visual observation.

The Norwegians have been working with the RAMS system for more than a year. For example, they have been using buoys to track ice drifting in the Spitzbergen region of the Barents sea, north of Norway.

Nimbus-6, a multi-purpose weather and data collection satellite, was launched into polar orbit on board a Delta rocket June 12, 1975.

## NASA Film Wins Top Award

In May, "Universe," a NASA motion picture, won the Chairman's Special Award (Best of Festival) at the 10th Annual U.S. Industrial Film Festival. The competitors for this prize included 970 motion pictures from five nations. The three finalists were the Smithsonian Institution's "To Fly," I.B.M.'s "Parade of the Tall Ships" and NASA's "Universe." The event is rated as one of the country's five most important film festivals.

"Universe," produced for NASA by Graphic Films during 1977, was nominated for an Academy Award, won a CINE Gold Eagle rating, won a bronze medal at the 19th Annual San Francisco Festival and an award from the Golden Gate Festival.

The film will represent the United States as an entry in scores of international film festivals this year.

## NASA's Lomax Is Honored

A NASA employee received one of two awards given for achievements in aerospace—for contributions to fluids and plasmadynamics—from the American Institute of Aeronautics and Astronautics in Albuquerque, N.M. at a conference held June 28. The recipient was Howard Lomax, chief, computational fluid dynamics branch at NASA's Ames Research Center.

The Fluid and Plasmadynamics Award is presented annually "for outstanding contributions to the understanding of the behavior of liquids and gases in motion, and of the physical properties and dynamical behavior of matter in the plasma state as related to needs in aeronautics and astronautics." It was presented to Lomax with the following citation: "For outstanding contributions to the theoretical analysis of supersonic aerodynamics by small perturbation theory, and to the computer simulation of aerodynamics problems by pioneering research in the development of numerical methods with application to computational fluid dynamics." The award consists of a medal and a certificate of citation.

Lomax joined the NACA Ames Aeronautical Laboratory in 1944 as a research scientist. During the late 1940s and early 1950s, he was one of the NACA's leading contributors of theoretical analyses of linearized supersonic flow over wings and wing-body configurations. In the late 1950s, when NACA became NASA and the research emphasis changed from aircraft to missiles and reentry vehicles, Lomax shifted his attention to bluntnosed or axisymmetric bodies and their aerodynamic characteristics, developing flow-field and characteristics programs still in use today.

In the 1960's Lomax pioneered the use of interactive graphic displays in fluid dynamic calculations, allowing the scientist-programer to monitor calculations-in-progress on a cathode ray tube. More recently, he has made major contributions to the field of computational fluid dynamics as a viable alternative to wind tunnel tests, including the development of specialized program languages, the study of numerical methods, and the solution of aerodynamic problems related to subsonic, transonic, and supersonic speeds.

In 1970, Lomax became chief of the computational fluid dynamics branch at Ames. He directs the research activities of 22 scientists and seven National Research Council postdoctoral associates, a team that is internationally recognized in its field.

## Scientist Uses Satellite Images to Catch Sport Fish

A NASA satellite orbiting 912 kilometers (570 miles) above the Earth pointed the way to a prime source of lake bass for a fisherman-scientist with the U. S. Geological Survey, Department of the Interior. He is Dr. Alden P. Colvocoresses ("Colvo"), a mapmaker and remote sensing specialist at the USGS National Center, Reston, Va., and the choice bass fishing spot is in Lake Anna on the North Anna River separating Louisa and Spotsylvania Counties in Virginia, about 35 miles north of Richmond.

The satellite is NASA's Landsat-1 Earth resources survey satellite, which orbits the Earth from pole to pole 14 times a day recording images of and data from the Earth's surface for a variety of purposes and users. Colvocoresses' studies added to the list by showing that Landsat can be used to find a good place to fish for bass.

Like many an avid fisherman, he is reluctant to disclose exactly where his favorite fishing place is on the 24-kilometer (15-mile) long, 20 square-mile (13,000-acre) Lake Anna. But he's more than willing to relate how he used Landsat images of the lake to pick out good fishing areas in a technique he said might be used by other fishermen to locate other good fishing areas.

Lake Anna was created by the Virginia Electric and Power Co. in the early 1970s as a huge cooling pond for a nuclear power plant, not yet in operation. Colvo initially acquired Landsat images of the area as part of his work to demonstrate that Landsat could be used to revise and update maps, and to use in

revising the state base map of Virginia and other USGS maps of the area.

But, veteran fisherman that he is, Colvo also saw the possibilities for using the space-age images to help him in his favorite hobby. His approach was based on the premise that the large-mouth bass inhabiting Lake Anna prefer to feed in relatively shallow areas near deeper waters to which they can move if danger threatens.

Colvo examined an October 11, 1972 image acquired by Landsat-1 less than three months after the satellite was launched and at a time when Lake Anna was still filling and was about 2 meters (nearly six feet) below its planned permanent water level. By comparing the above-water areas on the first image with later Landsat images and topographic maps made after the lake had filled, Colvo was able to note the two m depth contour with more accuracy than he could on existing topographic maps, which have contour intervals of 3 m (10 ft.) or more, do not show underwater contours of many lakes, and are sometimes of dubious contour accuracy. If topographic maps with underwater contours do exist, they should be used along with the space imagery, Colvo advises.

**Space Age Fisherman**—Dr. Alden P. Colvocoresses, the U.S. Geological Survey scientist who used Landsat satellite images to pick out good bass fishing spots on Lake Anna in Virginia, is shown checking his fishing gear.

He first tested his theory in 1974, at a carefully selected spot in Lake Anna. Within 10 minutes of his first cast, he caught a three-pound bass, and on numerous later trips to Lake Anna he caught many other bass at this and other spots selected from Landsat images. His favorite spot remains the place where he caught that first bass, which he calls "ERTS Point." ("ERTS," for Earth Resources Technology Satellite, was the name of Landsat until 1975.)

"But I'm not about to tell anyone where ERTS Point is," Colvo said, adding that, "other bass fishermen shouldn't get the idea that this is a fishing gold mine where they can pull in a mess of bass in an hour's time. It still takes patience and waiting and know-how." His biggest catch to date is a 1.8 kilogram (4½-pound) bass.

The USGS scientist said other fishermen can use his technique of finding good bass spots because Landsat images are available to anyone in the world, at nominal cost, from the Interior Department's USGS- managed EROS (Earth Resources Observation Systems) Data Center in Sioux Falls, S.D. He said now might be a particularly good time because many lakes and reservoirs have lower-than-normal water levels in the wake of reduced rainfall in many parts of the nation.

"To apply this method," Colvo said, "the Landsat image must have been taken when the lake was at the right level, say six feet below the normal pool level where most fishing is done. The fisherman must find out when such appropriate water levels occur and request Landsat images taken at that time since the EROS Data Center does not have water level information." He advised that "Band 7" Landsat images should be specified when ordering since they depict water bodies better than the other three spectral bands in which Landsat images are acquired.

"The two Landsats take images of the various parts of the United States at least once every month," he added. "Unless cloud cover interferes, there is a good chance of getting a Landsat image within a few weeks of any date at which a lake is known to have been at the desired level. Landsat imagery dating back to July 1972 is available from the EROS Data Center."

Anyone interested in getting Landsat images should write to User Services, EROS Data Center, Sioux Falls, S.D. 57198, for prices and information on ordering. Each Landsat image depicts an area covering 185x185 kilometers (115x115 miles), or 34,250 square kilometers (13,225 square miles). The standard black and white 18.5x18.5-centimeter (7.3x7.3-inch) Landsat image sells for $8.00.

**A-Plus Student Engineer**—Pamela Melrose, 23, an engineering draftsman in the systems engineering division at the Langley center recently was selected as the outstanding junior student at the Old Dominion University in Norfolk. Pam, who completed the NASA apprentice school, is enrolled in the university's mechanical engineering curriculum. She now holds an associate degree in mechanical technology and an associate degree in drafting and design technology.

## Satellites Aid Subtropical Farmers

The price of many items from subtropical regions of the country depends on the human ability to predict just where and when weather will affect the multi-billion dollar citrus and vegetable belts. For the citrus industry alone, costs run about $36,000 per hour just to keep the work crews on standby on the chance that they might have to operate costly protection devices. The expense of "firing up" to protect groves can run to $5 million per night.

Soon to improve our forecast ability will be computerized predictions of frost and freeze areas that use Earth images taken at 30-minute intervals by GOES-1, the weather prediction satellite. NASA launched GOES-1 for the National Oceanic and Atmospheric Administration. The satellite is designed primarily to provide weather forecasters with day and night cloud-cover photographs of much of the western hemisphere.

The pay-off point, expected soon, stems from a four-year effort by NOAA's National Weather Service, the University of Florida, and the Kennedy Space Center to develop a computerized and highly accurate means of forecasting freeze lines. Although the new tool is being developed with the immediate needs of Florida agriculture in mind, its promise is great for application anywhere in the nation where cold-sensitive crops are grown.

The new prediction system will be installed in the weather service's office at Ruskin on the east side of Tampa Bay this year. Managers of the program hope it will be operational in time for next winter's crops.

Daytime cloud pictures taken by GOES-1 are in visible light; those at night are taken in infrared light not visible to the human eye, revealing heat reflections instead of actual objects.

The technique could be applicable to peaches in Georgia, cranberries in New Jersey and Wisconsin, apples in Washington state, and the citrus crops of California's Imperial Valley and the Rio Grande Valley of Texas.

## New Space Center Opens

Four former University of Michigan students—Astronauts James A. McDivitt, Jack R. Lousma, and Alfred M. Worden, and NASA's Robert F. Freitag—on May 7 dedicated the new Michigan Space Center at the Jackson Community College, Jackson, Michigan. Freitag, deputy director in NASA's Advanced Programs component, was the keynote speaker.

As military jets flew overhead, sky divers dropped out of the blue, a helicopter took spectators for rides, and popcorn stands did a brisk business, the astronauts signed hundreds of autographs and local citizens roamed through the gold-domed science center. The exhibits include the original Apollo 9 capsule, a Mercury capsule, astronaut clothing and and equipment, a surveyor craft displayed on a replica of the Moon's surface where it landed, a full-scale mockup of Mariner 4, and—just outside the geodesic dome—the original 25 meters (83-foot) Mercury Redstone rocket. It is the last Redstone rocket still in prime condition. Most of the material on display was loaned by NASA or the Smithsonian Institution.

The Michigan Space Center is an educational facility with special courses and public events linked to the space program. It features noted astronauts, scientists and specialists as lecturers. Special events, seminars and meetings are held in the astro theater.

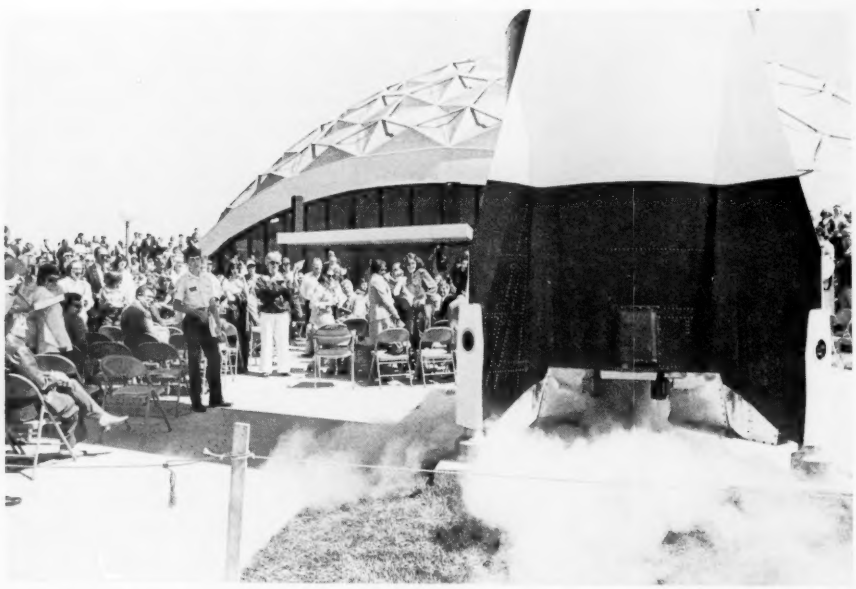
Open to on-campus students and teachers, as well as to school children and the general public, the

display area is entered through a "transition tunnel" that features flashing lights, astronaut chatter and eerie music to get visitors in the mood for the exhibits.

In his ribbon-cutting speech, aerosopace engineer Freitag praised the concept of the new center, calling it an educational boon to Michigan He remarked on the tremendous strides that have been made in aeronautics and space efforts since he earned his degree in 1941, pointing out that "there were no jet airplanes, no television and no computers" when he attended the Jackson Community College in the late 1930s but that the future holds even greater promise. He added that once the Space Shuttle is in operation man will be able to manufacture items in space that cannot be made on the ground as well as obtain energy from space. "In a few short years, occupancy of space by men and women working in space will become a reality. There will be a 'Telephone Central' in space."

The self-supporting space center is owned by the community college, which paid half the construction cost of about $750,000. The state paid the other half. A campaign is on now to increase impressive pledges and donations already received from the private sector. The money so far collected will be used for additional exhibit design, transportation and refinishing.

**Big Day at Jackson Community College**—NASA's Robert F. Freitag was chosen to cut the ribbon at dedication ceremonies for the Michigan Space Center. (Courtesy of *Citizen Patriot.*)



**Pretend Blast-off**—A simulated launch of the Redstone rocket which stands in front of the space center at Jackson Community College was part of opening-day festivities. In the background is the gold geodesic dome in which air and space equipment and vehicles are on display. (Photo used through courtesy of *Citizen Patriot.*)

**Dedication of Michigan Space Center**—Astronauts Jack Lousma (background) and James McDivitt, Jr. (foreground) inscribe their names in wet cement at opening day ceremonies. (Photo used through courtesy of *Citizen Patriot*.)

## University to Continue Lightning Study

A study of the effects of lightning strikes, underway since 1972, will be continued under a Kennedy Space Center $16,200 supplemental grant to the University of Florida. Data gathered from the study ultimately could lead to the development of an operational system which would be used by the Spaceport to forecast lightning hazards and determine the extent of damage to remote structures or aerial and underground cables.

The value of this study is most important to the safety and efficiency of all aspects of Space Shuttle processing, launch and landing operations, according to William Jafferis, staff assistant to the space vehicle operations director and technical monitor for the study.

University personnel have been working consultants with engineers from KSC's space vehicle operations and information systems directorates, using advanced lightning instrumentation presently at KSC.

The principal instrument to be used in the forthcoming studies is the lightning detection and ranging (LDAR) device. It is designed to measure the sources of high frequency radiations being emitted from lightning activity going on within a cloud. Under the supplemental grant, the LDAR system will be modified, enabling it to locate cloud-to-ground lightning strikes to any KSC facility.

The system also will measure precisely the intensity of a lightning strike, thus making it possible to assess damage to buried and aerial cables or systems tied to the cables accurately and immediately. Data obtained from these studies will be invaluable to determining Space Shuttle ground support equipment susceptibility to damage from cloud-to-ground lightning.

A secondary goal of the supplemental grant is the construction of a baseline lightning location system using four TV cameras. It will be used to determine the accuracy of other lightning detection instruments located throughout the center.

"Only a few years ago, if a launch complex was struck by lightning, the vehicle would be removed and tested to determine how much damage, if any, it had sustained," Jafferis said. "But with the development of this operational system, every characteristic of a lightning strike, where it hit, how hard it hit and what it hit—even to the extent of knowing whether it struck a vehicle or damaged some underground cable —will be known immediately. And the entire KSC complex can be monitored from one base facility."

The additional grant brings to $55,196, the total amount awarded to the University of Florida for the lightning study program.

## Secretarial Contributions Honored at Ames

More than 350 people attended the Secretary/ Executive breakfast held recently at NASA's Ames Research Center. Held in observance of Secretaries' Week, the event was co-sponsored by the local National Secretaries Association Chapter (Mission Trail) and the Ames Employee Advisory Groups (particularly the Women's Advisory Group).

The Ames cafeteria was transformed into a banquet hall for the event. Half of those in attendance were Ames secretaries and bosses, the other half were secretaries and executives from organizations and industries in the local area: realty offices; publishing companies; high school, college and university offices; consulting firms, electronic and aerospace firms; city offices; and nearby Federal agencies. The outsiders were given a tour of Ames at the conclusion of the program.

Judith Bergland opened the breakfast, on behalf of the Ames Women's Advisory Group, and Dr. Hans Mark officially welcomed everyone to Ames as one of his last official acts before leaving Ames as center director.

A highlight of the program was the presentation of secretarial awards to three Ames secretaries who had been selected on the basis of letters from their supervisors and a review by a selection committee. This is the first time such awards have been given at

Ames. Award winners were: Doris Furman of the life sciences directorate, Oldine Kersten of the research support directorate, and Nadine Omlio of the astronautics directorate.

"The Boss-Secretary Management Team" was the topic of the keynote speaker, Dr. Robert Dyer. He emphasized the importance of "real communication" within the team to provide an efficient and effective office operation. Dr. Dyer asked that 15 minutes be set aside each week as a time for the boss and secretary to discuss common goals, office activities or problems. His talk was extremely well received.

The breakfast was deemed a huge success, and involved personnel hope to make it an annual event.

## Contractor News

**Universities Space Research Assn.,** of Houston, a university consortium, will provide scientific support for the development of the atmospheric cloud physics laboratory under a Marshall center contract recently awarded. The contractor is called upon to review scientific aspects of experiment proposals, assist the project scientist by providing a liaison function between NASA and the cloud physics community, and conduct feasibility studies for future experiments.

**The Douglas Aircraft Co.** of Long Beach, Calif. (a division of the McDonnell Douglas Corp.) has won a $2.3 million NASA contract to investigate selected advanced aerodynamic and controls concepts for future energy-efficient civil transport aircraft.

**The Martin Marietta Aerospace, Denver division,** has received a contract worth $978,217 from NASA's Marshall center for construction work on a test stand to be used in the Space Shuttle test program. The contract calls for revitalization of the hydrodynamic support system used in the 1960s for Saturn V dynamic testing.

**The McDonnell Douglas Corp.,** Douglas Aircraft Co. of Long Beach, Calif., has been awarded a $15.6 million NASA contract to develop and evaluate advanced composite vertical stabilizers for DC-10 transport aircraft. Costs of the definitive contract will be shared, with NASA contributing approximately $15.6 million and the contractor about $1.7 million. The program, managed by the Langley Research Center, is aimed at accelerating the use of composite structures in new aircraft by developing technology and processes for introduction of such structures into commercial transport aircraft.

**Rockwell International's Space Division** in Downey, Calif., has won a Marshall center contract worth $695,000 for a satellite power system study that will provide additional data relative to the technical, social and economic value of the concept.

**The Computer Sciences Corp.** of Falls Church, Va., has been selected by NASA for the award of a contract for communications and instrumentation support services at the Kennedy Space Center. The cost-plus-award-fee contract, covering three years, is valued at about $41 million.

A contract with the Rocketdyne division of **Rockwell International** has been amended by the Marshall center to allow for additional work and services in the Space Shuttle main engine program. The modification authorizes long lead hardware and material procurement to provide follow-on engines.

**The Wyle Laboratories** of Hampton, Va. have been awarded a contract to provide electronic instrument support for the Langley center. The work centers on instrument inspection, calibration, maintenance and application to satisfy the measurement requirements of tests conducted at Langley test facilities. It involves some 30,000 instruments and transducers valued at more than $50 million. The five-year effort is valued at about $23 million.

**The Lockheed-California Co.,** a division of Lockheed Aircraft at Burbank, Calif., has won a NASA contract to demonstrate technology for composite vertical stabilizers for the L-1011 aircraft. Costs of the contract will be shared, with NASA contributing $15.7 million and the contractor $1.7 million. Managed by the Langley center, the work will be performed over six-and-a-half years.

**Planning Research Corp.** of McLean, Va., has won a $25,720,364 contract extension for engineering support services from NASA's Kennedy center. The 12-month, cost-plus-award fee contract extension provides for the corporation to continue design engineering support services for the Space Shuttle program and other activities for which the center has design responsibilities. The extension brings the total amount of the contract, originally awarded in 1974, to $72,616,061. ■■■

## Radio-Television

(*Released nationally*)

**TELEVISION:** A 14½-minute and a 90-second film have been released in the *Aeronautics and Space Report* monthly series. Its title is "Space Shuttle Approach and Landing Tests."

**RADIO:** Four weekly *Space Story* programs have been released—"Halley's Comet Mission 1986" (feat. Marcia Neugebauer); "HEAO-A4" (feat. Dr. Walter Lewin, MIT); "The Orbiter Enterprise" (feat. Astronaut Fred Haise); and "National Space Observation Week." One monthly NASA *Special Report* has been released—"The Space Shuttle Orbiter" (feat. Astronauts Fred Haise, Gordon Fullerton, Joe Engle and Dick Truly).

# Did You Know?

**By early May, 591 applications** had been received at the astronaut candidate program office (JSC) for civilian astronaut pilot and mission specialist candidate positions. Of those, 359 were from women. June 30 was the final date for receipt of applications.

**In mid-May, the launch of a U.S. military communications satellite** brought to 10,000 the number of manmade objects that have been sent into space, according to the North American Air Defense Command.

**More than 103,700 visitors** took guided tours of the Kennedy center and Cape Canaveral installations last April, a slight decline below figures for the previous April. So far in 1977, 381,454 people have toured the NASA facility.

**The final countdown** for the Space Shuttle at NASA's Kennedy Space Center in Florida is expected to require only 2½ hours as compared to the 28 hours needed for the final countdown of an Apollo/Saturn V.

**The USSR Aeronautical Sporting Federation** recently awarded medals and certificates to 20 Johnson center and contractor employees for their contribution to the success of the Apollo Soyuz Test Project. Five individuals received the S. Korolov medals/certificates; 15 were given Yuri Gagarin diplomas. The two contractor employees on the list work for the TRW defense and space systems group. ■■■

## New NASA Publications

**"Space Settlements"** (SP-413) is a 185-page volume with color illustrations, devoted to engineering systems that might permanently sustain human life in space on a large scale. The authors are those individuals who participated in the 1975 Summer Faculty Fellowship Program in Engineering Systems Design. Sponsors of the publication are NASA, and the American Society for Engineering Education; direction was by the Ames Research Center and Stanford University. Chapters cover: the settlement of space; physical properties of space; human needs in space; choosing among alternatives; a tour of the settlement; building the settlement and making it prosper; view to the future; and recommendations and conclusions. The Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, sells the book for $5.00 (with paper cover).

**"Why Man Explores"** (EP-123) is a 94-page booklet produced by NASA's Office of Public Affairs, which features a wide-ranging unrehearsed discussion of exploration by Norman Cousins, Jacques Cousteau, Ray Bradbury, James Michener and Philip Morrison. The edited transcript was prepared directly from audiotapes of the panel session held at the California Institute of Technology in July 1976 in connection with the Viking spacecraft landings on Mars. The volume is for sale by the U.S. Government Printing Office for $1.10.

**Mogavero in the Spotlight**—Louis Mogavero, NASA's director of the technology utilization office at headquarters, was awarded the Department of Commerce Certificate of Appreciation for his collaboration in a joint NASA—National Bureau of Standards project. Mogavero, in exploring ways that aerospace technology could assist the performing arts by improving productivity, initiated the "Star Tracker" project to demonstrate the feasibility of an automated spotlight. He worked with Edwin G. Johnson, and Drs. John M. Evans and James S. Albus, all of the office of developmental automation and control technology (NBS), in developing the concepts for the spotlight control system to track moving performers on a stage. The concepts developed are potentially applicable to sports, law enforcement and automated warehousing. NBS built proof-of-concept equipment using computer controlled automation techniques. NASA has applied for a patent on the system. Dr. Ruth M. Davis, director of the Institute for Computer Science and Technology (NBS), presented the certificate to Mogavero.

## Inventions and Contributions Board Monetary Awards

*The Inventions and Contributions Board has recommended that monetary awards be granted to the NASA employees identified on the attached list for scientific and technical contributions to space and aeronautical activities. The recommendations were approved by the Administrator and awards have been made.*

| Innovator(s) | Title of Invention and Contribution |
|---|---|
| **AUBURN UNIVERSITY** | |
| Martial A. Honnell | Automatic Frequency Control for FM Transmitter |
| **GENERAL DYNAMICS** | |
| Roy F. Holmes, Edward E. Keller | An Improved Heat Exchanger |
| **HONEYWELL** | |
| Ted J. Podgorski | Glass-to-Metal Seal |
| **INDIAN INSTITUTE OF TECHNOLOGY** | |
| Parampukattil K.C. Pillai | Charge Injection Method and Apparatus of Producing Large Area Electrets |
| **JET PROPULSION LABORATORY** | |
| Alexander S. Irons, Paul P. Muehter, Willie D. Kent | Heat Sterilizable Patient Ventilator |
| Tage O. Anderson | Computer Interface System |
| Charles C. Kirsten | Solar Powered Pump |
| Wayne M. Phillips | High Temperature Oxidation Resistant Cermet Compositions |
| Alain L. Fymat | Scattering-Independent Determination of Absorption and Emission Coefficients and Radiative Equilibrium State |
| Wayne M. Phillips | High Temperature Resistant Cermet and Ceramic Compositions |
| Maurice J. Argoud, Jack Jolley, Walter L. Walker | Lightweight Reflector Assembly and Method for Producing the Same |
| Alain L. Fymat | Forward-Scatter Polarimeter for Determining the Gaseous Depolarization Factor in The Presence of Polluting Polydispersed Particles |
| Loyis F. Schmidt, George D. Pace, Jr. | Sun Direction Detection System |
| Melvin M. Saffren | Method and Apparatus For Generating Coherent Radiation in the Ultra-Violet Region and above By Use of Distributed Feedback |
| Melvin M. Saffrenq | A Doped Josephson Tunneling Junction for Use in a Sensitive IR Detector |
| Alain L. Fymat | Frequency Scanning Particle Size Spectrometer |
| Alain L. Fymat | Particle Size Spectrometer and Refractometer |
| William A. Mueller, George C. Hsu, Harold E. Marsh | Aldehyde-Containing Urea-Absorbing Polysaccharides |
| Rudolf A. Schindler | Interferometer Mirror Tilt Correcting System |
| Charles G. Miller, Jens H. Pohl | Portable, Linear-Focused Solar Thermal Energy Collecting System |
| Charles G. Miller, Jens H. Pohl | Three-Dimensional Tracking Solar Energy Concentrator and Method |
| Taylor G. Wang, Daniel D. Elleman | Acoustic Energy Shaping |
| Richard J. Stirn, Yea-Chuan M. Yen | Schottky Barrier Solar Cell and Method of Fabricating It |
| **LOCKHEED** | |
| Alexander Pechman, Robert M. Beasley | Three-Component Ceramic Coating for Silica Insulation |
| **MASSACHUSETTS INSTITUTE OF TECHNOLOGY** | |
| Jacob H. Martin | Heat Transfer in Electronic Equipment |
| Jacob H. Martin | Thermally Integrated Electronic Assembly with Tapered Heat Conductor |

**NATIONAL ACADEMY OF SCIENCE**
Dr. Edward B. Igenbergs ..... Two Stage Light Gas-Plasma Projectile Accelerator

**NATIONAL BUREAU OF STANDARDS**
Edwin G. Johnson, Hohn M. Evans, James S. Albuts ..... System and Method for Tracking Signal Source

**ROCKWELL INTERNATIONAL CORP.**
John J. Vrolyk ..... High Temperature Transducer
Thomas R. Oeffinger, Leonard R. Tocci ..... Passive Chevron Replicator

**SPERRY RAND CORPORATION**
Dan L. Shady ..... A Device for Tensioning Test Specimens Within An Hermetically Sealed Chamber

**COOPER UNION**
Shang-I Cheng ..... Pyrolysis System and Process

**UNIVERSITY OF CALIFORNIA**
George F. Smoot, William L. Pope, Lawrence Smith ..... Low Gravity Phase Separator

**WESTINGHOUSE ELECTRIC CORP.**
David L. Farnsworth ..... Solid-State Current Transformer
Paul Rovelstad Malmberg ..... Rapid Exposure of Micropatterns With a Scanning Electron Microscope

**XEROX CORPORATION**
Lawrence Jan, Gale Gant ..... A Non-saturating Parallel Converter Without Collector Current Overlap

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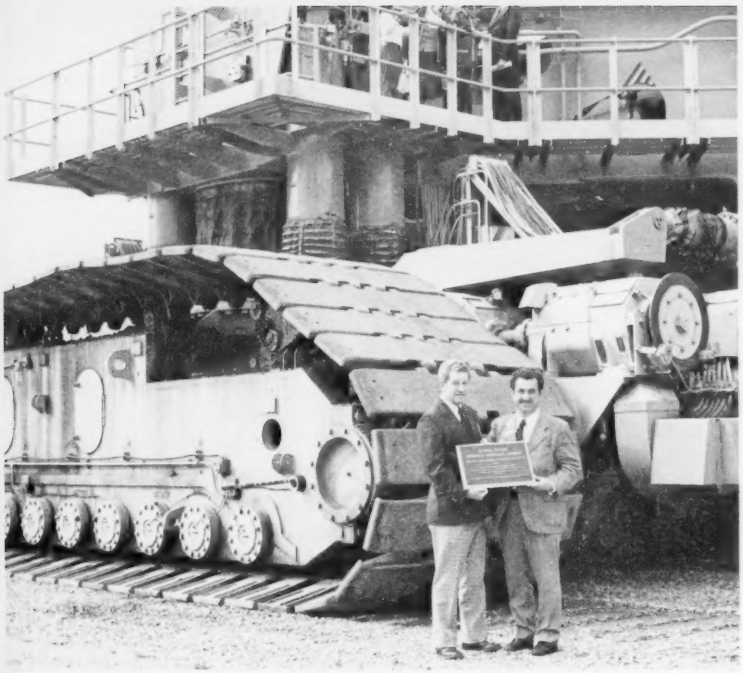
**One of a Kind**—The only woman to have flown in space, Valentina Tereshkova examines the Apollo 17 command module "America" with Apollo and Skylab astronaut Alan Bean who escorted the Russian cosmonaut on a recent visit to the Johnson Space Center. Tereshkova is in the U.S. on a tour for *Good Housekeeping* magazine. She spent three days in space in June 1963 on the Soviet Vostok mission. She is married to cosmonaut Maj. Gen. Andriyan Nikolayev.

**Scientific Publication Wins Award**—Dr. William F. Ballaus (left), aerospace engineer with the Ames directorate, U.S. Army Air Mobility Research and Development Laboratory, receives the 1977 H. Julian Allen Award and a $1,000 check from Dr. Hans Mark, former director of the Ames center, for co-authoring a scientific paper judged the best produced at the center during 1976. In remarks concerning the award, Dr. Mark said: ". . . What is important about this award is that Dr. F. R. Bailey is a NASA employee and Dr. Ballhaus an Army employee, and yet they were able to work together in a collaborative way so that an extremely important result was obtained. I believe that this collaborative work is excellent proof of the flexibility that we have built into the system here, and I hope and expect that we will be able to continue to work in this way in the future." (NASA and the Army laboratory share research facilities at the Ames center.)

## Launches for 1977—Completed and Projected

| Name | Launch Date | Vehicle | Range | Mission Remarks |
|---|---|---|---|---|
| NATO-3 B | Jan. 27 | Delta | ETR | Second communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable. |
| Palapa-2 | March 10 | Delta | ETR | Back-up satellite for Indonesian domestic communications network. Reimbursable. |
| GEOS/ESA | April 20 | Delta | ETR | ESA spacecraft to conduct scientific investigation of waves and particles in magnetosphere. Reimbursable. Failed to reach correct orbit. |
| Intelsat IVA-C | May 26 | Atlas/Cen. | ETR | High Energy Astronomical Observatory to study energetic radiation from space. |
| GOES/NOAA | June 16 | Delta | ETR | Second operational satellite to provide continuous daytime and nighttime global cloud cover observations for NOAA. Reimbursable. |
| GMS-Japan | July 14 | Delta | ETR | Geosynchronous Meteorological Satellite. Japanese portion of global network of geostationary environmental satellites. Reimbursable. |
| SIRIO-I | Aug. 11 | Delta | ETR | Italian project to investigate radio propagation, trapped radiation flux, magnetic field intensity and variation, and the primary electron energy spectrum. Reimbursable. |
| Voyager 1 | Aug. 20 | Titan III Centaur | ETR | Jupiter and Saturn planetary systems and the interplanetary medium out to Saturn. |
| Voyager 2 | Aug. 30 | Titan III Centaur | ETR | Same as above. |
| HEAO-A | Aug. or Sept. | Atlas/Cen. | ETR | High Energy Astronomical Observatory to study energetic radiation from space. |
| OTS/ESA | Sept. 8 | Delta | ETR | Orbital Test Satellite. ESA experimental communications satellite. Reimbursable. |
| Landsat-C | Sept. | Delta | WTR | Third Earth resources technology satellite. |
| RCA-C | Sept. | Delta | ETR | Third domestic communications satellite for RCA. Reimbursable. |
| Meteosat | Sept. | Delta | ETR | ESA meteorological satellite. Reimbursable. |

**National Award to Marshall Employee**—Jeanette A. Scissum, an aerospace technologist in space sciences at the Marshall center, has won the National Technical Association's National Tribute Award. Her co-workers in the Huntsville chapter of the NTA nominated Scissum for her "outstanding efforts towards the Alabama A&M University summer program and the center's black history program." The award will be presented at the annual NTA convention on Aug. 5 at Hampton, Virginia.



**Super Crawlers**—The Kennedy center's two massive crawler transporters, which were used to carry Saturn rockets to the launch pads, have been designated National Historic Mechanical Engineering Landmarks. A plaque was presented to (left) Raymond L. Clark, director of KSC's design engineering by Dr. Stothe P. Kezies, director of the Georgia Institute of Technology school of engineering. This was the second award received by NASA for these mechanical marvels. Another—the Diamond Jubilee Trophy—was presented by Britain's Royal Automobile Club. With all the fanfare about the ASME "historical" and "landmark" honor, it should be noted that the transporters are by no means going into moth balls. On the contrary, modifications are presently underway for the 12-year-old transporters to be used in the Space Shuttle program. Each of the 39-meter (131 feet) long, 34-m (114 ft.) wide, 2,760 million kilogram (six million pound) vehicles have logged more than 500 miles of travel. Now they are being beefed up to cover some 8,045 Km (5,000 miles) each, ferrying Shuttle launch equipment to and from launch sites.

**Safer Bridges Being Built**—NASA-developed "fracture toughness" test procedures are being used by U.S. Steel Corp. to check the structural integrity of bridges. The New River Bridge in West Virginia, shown under construction, is the world's largest single span bridge. The testing procedure, to determine the metal's ability to resist cracks that might cause failure, was developed by the NASA Lewis Research Center.

# Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

## New Help for the Sightless

Thanks to an aid called the Optacon, a blind person may be reading this printed page. The Optacon is a compact, portable reading aid that gives blind and deaf-blind people independent and immediate access to the world of print. Using advanced electronics, the Optacon converts the image of a printed letter into a vibrating tactile form that a blind person can feel with one finger. Different type styles and languages can be read with the Optacon because it reproduces exactly what is printed. The usual step of tape or braille transcription is thus eliminated, providing Optacon users with a new degree of independence and privacy.

Once equipped with this ability to read print directly, sightless people can independently carry out many everyday tasks. Optacon users can read their own bank statements and bills; identify package labels; follow recipes in printed cookbooks; and even read storybooks to children. Personal letters and correspondence can be read privately. The Optacon also expands the range of reading materials available to the blind by enabling them to enjoy books and magazines that are neither recorded nor brailled.

The system can be an important aid in schools, inasmuch as it makes the instructional and resource materials of the sighted directly usable by the blind. Departments of education, local school boards and private schools have initiated programs to make Optacon instruction available to blind students. (Training courses for teachers are available from the Optacon manufacturer.) Primary grade students use the device in learning to read; high schools and community colleges have integrated Optacon instruction into their vocational education programs; and university students use it to pursue advanced studies in the sciences, foreign languages, law and other fields.

The Optacon has helped blind people to obtain jobs, to advance on the job and to enter vocational areas previously closed to them. A blind computer programmer, for instance, in addition to being able to read a printout, can easily adapt the Optacon to directly read the luminous display of a cathode ray tube terminal. A typewriter attachment enables a blind secretary to read what is being typed, make typing corrections, and fill out preprinted forms. Another accessory enables a blind engineer or scientist to use the Optacon to read the visual display of an electronic calculator.

The Optacon system originated in research performed at Standard University under NASA-Ames Research Center sponsorship. The manufacturer is Telesensory Systems Inc., 1889 Page Mill Rd., Palo Alto, Calif. 94304.

(NASA does not endorse commercial products developed as a result of its patent licensing or technology utilization programs, but it does encourage the widest possible use of its technology.)

This blind boy is reading with the aid of the Optacon. He is passing a mini-camera over a printed page with his right hand; with his left he is sensing a vibrating image of the letters the camera is viewing. The portable, battery-powered Optacon weighs just 1.8 kilograms (four pounds) and is about the size of a small cassette tape recorder.

NASA

National Aeronautics and Space Administration

"For the benefit of all . . ."